1. INTRODUCTION

Chapter 1 provides an overview of the U.S. Department of Energy's proposal for treatment and management of sodium-bonded spent nuclear fuel. This chapter discusses the background, purpose and need for agency action, and scope of the *Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*. Included are discussions on the decisions to be made and issues identified by the public during the scoping and public comment periods. The chapter concludes with sections on the relationship of this proposal to other actions and programs under the National Environmental Policy Act and the organization of the document.

1.1 BACKGROUND

For nearly four decades, research, development, and demonstration activities associated with liquid metal fast breeder reactors were conducted at the Experimental Breeder Reactor-II (EBR-II), about 40 miles west of Idaho Falls, Idaho; the Enrico Fermi Atomic Power Plant[1] in Monroe, Michigan; and the Fast Flux Test Facility at the Hanford site in Richland, Washington. These activities generated approximately 60 metric tons of heavy metal of sodium-bonded spent nuclear fuel for which the U.S. Department of Energy (DOE) is now responsible. Sodium-bonded spent nuclear fuel is distinguished from commercial nuclear reactor spent nuclear fuel by the presence of metallic sodium, a highly reactive material; frequently by metallic uranium and plutonium, which are also potentially reactive; and in some cases, highly enriched uranium. Metallic sodium in particular presents challenges for management and ultimate disposal of this spent nuclear fuel. For example, metallic sodium reacts with water to produce explosive hydrogen gas and corrosive sodium hydroxide; both could affect operation of a geologic repository.

DOE proposes to resolve this problem by treating and managing the sodium-bonded spent nuclear fuel and facilitating its ultimate disposal in a geologic repository. The reasonable alternatives for this proposed action are determined by the technology options available to DOE. Several technologies that might be used to treat and manage DOE's sodium-bonded spent nuclear fuel are at various stages of development. Among these are: an electrometallurgical treatment process; the plutonium-uranium extraction (PUREX) process; placement of the spent nuclear fuel in high-integrity cans; a melt and dilute process; a glass material oxidation and dissolution system (GMODS) process; a direct plasma arc-vitreous ceramic process; and a chloride volatility process.

The programmatic risk in implementing any of these potential alternatives for treatment and management of sodium-bonded spent nuclear fuel, or of not treating this fuel, is the uncertainty surrounding the acceptability of DOE spent nuclear fuel for placement in a potential geologic repository. While DOE has drafted preliminary waste acceptance criteria for a geologic repository (DOE 1999c), the final acceptance criteria will be more refined. If the proposed repository at Yucca Mountain in Nevada is developed, final acceptance criteria would not be available until about 2005, when the U.S. Nuclear Regulatory Commission (NRC) would issue a construction authorization. Until such time, the preliminary acceptance criteria are intended to be conservative to allow for uncertainties in the performance of engineered and natural barriers and how such performance might impact public and worker health and safety, as well as material isolation.

This environmental impact statement (EIS) follows the June 1, 1995, Record of Decision (60 FR 28680) for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact*

[1] *The original name of the plant was the Enrico Fermi Atomic Power Plant. The numeral "1" was added to the name in 1969 after Detroit Edison Company began construction of Fermi-2. The plant also is known as Fermi, Fermi-1, or Enrico Fermi-1.*

Statement (Programmatic Spent Nuclear Fuel EIS) (DOE 1995a), in which DOE decided to regionalize spent nuclear fuel management by fuel type for DOE-owned spent nuclear fuel. DOE also decided to: (1) continue environmental restoration activities at the Idaho National Engineering and Environmental Laboratory (INEEL)[2]; (2) develop cost-effective treatment technologies for spent nuclear fuel and waste management; and (3) implement projects and facilities to prepare waste and treat spent nuclear fuel for interim storage and final disposition. The l995 Record of Decision was based partially on the analyses in the Programmatic Spent Nuclear Fuel EIS, which analyzed the potential environmental consequences of alternatives for transporting, receiving, processing, and storing spent nuclear fuel under DOE's responsibility for the next 40 years. The Programmatic Spent Nuclear Fuel EIS also analyzed the consequences of 10 years of waste and spent nuclear fuel management and environmental restoration actions at INEEL.

In addition, DOE committed to remove all spent nuclear fuel from Idaho by 2035 in a 1995 agreement with the State of Idaho (Settlement Agreement and Consent Order [Idaho 1995] issued on October 17, 1995, in the actions of *Public Service Co. of Colorado v. Batt*, No. CV 91-0035-S-EJL [D. Id.], and *United States v. Batt*, No. CV 91-0054-EJL [D. Id.]). Currently, more than 98 percent of DOE's sodium-bonded spent nuclear fuel is located at INEEL near Idaho Falls, Idaho, and is subject to the requirements of this Settlement Agreement and Consent Order. Before sodium-bonded spent nuclear fuel can be removed from the State of Idaho for ultimate disposal, some or all of the fuel may require treatment.

One of the technologies considered for the treatment of sodium-bonded spent nuclear fuel is the electrometallurgical technology. In a 1995 report (NAS 1995), the National Academy of Sciences' National Research Council Committee on Electrometallurgical Techniques for DOE Spent Nuclear Fuel Treatment recommended that DOE confirm the technical feasibility and cost-effectiveness of electrometallurgical treatment of its sodium-bonded spent nuclear fuel. The Council recommended this be done through a technology demonstration using sodium-bonded spent nuclear fuel that had been removed from EBR-II at Argonne National Laboratory-West (ANL-W). Prior to acting on the recommendation, DOE prepared the *Environmental Assessment for the Electrometallurgical Treatment Research and Demonstration Project in the Fuel Conditioning Facility at Argonne National Laboratory-West* (DOE 1996a) and issued a Finding of No Significant Impact on May 22, 1996 (61 FR 25647). The Electrometallurgical Treatment Research and Demonstration Project, which began in June 1996, involved the treatment of up to 100 EBR-II driver spent nuclear fuel assemblies and up to 25 EBR-II blanket spent nuclear fuel assemblies (approximately 1.6 metric tons of heavy metal). The driver spent nuclear fuel contained highly enriched uranium and was used in the active region of the nuclear reactor core. The blanket spent nuclear fuel contained depleted uranium and was used in areas around and near the driver spent nuclear fuel in the reactor core. The Electrometallurgical Treatment Research and Demonstration Project was successfully completed in August 1999. The key analytical and experimental results of the demonstration project are provided in the *Spent Fuel Treatment Demonstration Final Report* issued by ANL-W (Benedict et al. 1999) in August 1999. The salient features of the demonstration project and results are discussed in Section 1.6.3.

Parallel to the assessment provided in this *Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (SBSNF EIS), the National Research Council is continuing to evaluate the Electrometallurgical Treatment Research and Demonstration Project. In its most recent report, *Electrometallurgical Techniques for U.S. Department of Energy Spent Fuel Treatment–Spring 1998 Status Report on Argonne National Laboratory's R&D Activity* (NAS 1998), the Council acknowledged progress in the demonstration and recommended that it be carried to completion. Data from the demonstration project were used in preparing this EIS. The National Research Council issued a final report on the technology demonstration in April 2000. DOE will consider the Council's final report in reaching a decision regarding the disposition of sodium-bonded spent nuclear fuel.

[2] *The laboratory's name was changed from Idaho National Engineering Laboratory to Idaho National Engineering and Environmental Laboratory in January 1997.*

1.2 PURPOSE AND NEED FOR ACTION

Sodium-bonded spent nuclear fuel contains metallic sodium. The presence of metallic sodium in the sodium-bonded spent nuclear fuel could potentially complicate disposal certification and licensing for the ultimate disposal of this spent nuclear fuel in a geologic repository. Metallic sodium reacts vigorously with water, producing heat, potentially explosive hydrogen gas, and sodium hydroxide, a corrosive substance. Sodium also is pyrophoric (i.e., a material that is susceptible to spontaneous ignition and continuous combustion). Sodium metal was used as a heat-transfer medium within the stainless steel cladding (outer layer) of the nuclear fuel and as a coolant in the nuclear reactors that used this fuel. To the extent possible, sodium was removed from the external surface of this fuel after its use, but a portion remains bonded to the uranium metal alloy fuel within the cladding and cannot be removed without further treatment. Most (i.e., 99 percent by weight) of the sodium-bonded spent nuclear fuel contains metallic uranium and plutonium. Some metals, such as pure uranium and pure plutonium, are reactive in the presence of air and moisture. The current preliminary repository waste acceptance criteria (DOE 1999c) exclude reactive and potentially explosive materials from being accepted into a geologic repository unless they exist only in trace quantities. Additionally, some of the sodium-bonded spent nuclear fuel contains highly enriched uranium that could create criticality concerns requiring control methods.

To ensure that the terms of the State of Idaho Settlement Agreement and Consent Order are met, and to facilitate disposal, DOE needs to reduce the uncertainties associated with qualifying sodium-bonded spent nuclear fuel for disposal. Appropriate treatment and management of the sodium-bonded spent nuclear fuel would significantly reduce complications related to disposal qualification. Technologies for spent nuclear fuel treatment that could facilitate such qualification therefore should be considered in reaching a decision for treatment of DOE-owned sodium-bonded spent nuclear fuel. Several treatment technologies are at various stages of development and could be used to remove and stabilize the metallic sodium and immobilize or isolate the transuranic and fission products that are in the sodium-bonded spent nuclear fuel. Such technologies include the electrometallurgical treatment process; the PUREX process; placement of the spent nuclear fuel in high-integrity cans; a melt and dilute process; the GMODS process; a direct plasma arc-vitreous ceramic process; and a chloride volatility process.

It is prudent to evaluate these alternative treatment technologies now, while DOE is performing site characterization activities for a potential geologic repository at Yucca Mountain, Nye County, Nevada. Potential waste forms resulting from treatment or packaging of sodium-bonded spent nuclear fuel should be developed as much as possible in parallel with any repository development. The process of establishing a repository depends on not only the site but also the materials for disposal. As part of this process, a total system performance assessment that describes the probable behavior of the repository is performed. This total system assessment includes the performance of the specific waste forms and inventories proposed for disposal. As part of the process of establishing a repository, data for the waste forms are needed prior to making a final repository selection.

Having completed the Electrometallurgical Treatment Research and Demonstration Project (see Section 1.6.3) and in considering the future of PUREX processing capabilities, DOE now needs to decide whether these technologies are suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying this NEPA process could result in a loss of capability and of technical staff knowledgeable about and experienced with the demonstration project. This was an important consideration in the decision to proceed with this EIS.

1.3 PUBLIC PARTICIPATION

1.3.1 Issues Identified During the Scoping Period

On February 22, 1999, DOE published in the *Federal Register* a Notice of Intent to prepare an *Environmental Impact Statement for Electrometallurgical Treatment of Sodium-Bonded Spent Nuclear Fuel in the Fuel Conditioning Facility at Argonne National Laboratory-West* (64 FR 8553). In this Notice of Intent, DOE invited the public to participate and comment on the proposed scope of the EIS. Subsequent to this notice, DOE held four public scoping meetings. The first meeting was attended by about 60 persons and was held in Idaho Falls, Idaho, on March 9, 1999. The second meeting was held in Boise, Idaho, on March 11, 1999, and was attended by 7 persons. Ten persons attended the third meeting, which was held in North Augusta, South Carolina, on March 15, 1999. The fourth meeting was held in Arlington, Virginia, on March 18, 1999, and was attended by 8 persons. A court reporter recorded oral comments at each of these meetings. Written statements or comments from the public also were collected at the meetings. In addition, the public was invited to send comments to DOE by letter, e-mail via the Internet, a toll-free telephone number, and facsimile. The public scoping comment period began with the publication of the Notice of Intent in the *Federal Register* on February 22, 1999 (64 FR 8553), and ended 45 days later on April 8, 1999.

A total of 228 comments were received during the public scoping comment period. All comments were reviewed and considered by DOE in developing the scope of this EIS. A summary of scoping comments and their disposition is provided in Appendix A of this EIS. The significant issues identified during the public scoping period are addressed below.

Many commentors at the public scoping meetings asked specific, technical questions about the proposed action. Areas of interest included:

Waste volume reduction
Nature of the spent nuclear fuel at ANL-W
Waste forms characterization
Waste disposition and qualification (repository acceptance criteria)
PUREX process
Use of facilities
Nonproliferation impacts
Transportation
Demonstration project

A number of persons commented on the schedule for this EIS. Many stated that the draft EIS should not be issued for public comment before publication of other related reports, such as the National Research Council's Waste Qualification Assessment and the National Academy of Sciences' Independent Assessment Final Report on the Electrometallurgical Treatment Research and Demonstration Project; a Nonproliferation Impacts Assessment; and an independent Cost Study. Several commentors said that this EIS is premature because the demonstration project will not be completed until after the draft EIS is published.

Several commentors asked that the EIS include information about the costs of the proposed action and all of the technology alternatives under consideration. Other commentors stated that the public should have an opportunity to comment on the Nonproliferation Impacts Assessment in the same time frame as the draft EIS, or that this EIS should be delayed until the Nonproliferation Impacts Assessment becomes publicly available. Some suggested that the Nonproliferation Impacts Assessment be included in the EIS. A few commentors expressed the opinion that electrometallurgical treatment of spent nuclear fuel is a proliferation-prone technology.

Many waste-related comments included opinions about whether low-enriched uranium, plutonium, noble metals, and other components of the waste stream should be viewed as waste or potentially valuable resources. Several commentors asked that the EIS clarify which specific waste forms would be generated by the treatment processes. Others said the EIS should clarify whether the waste would remain at the Savannah River Site (SRS) after processing or be returned to Idaho if the PUREX process were used. Some commentors argued that the electrometallurgical treatment alternative would not reduce the volume of waste to be stored in a repository. A few questioned how DOE can ensure the waste will meet the acceptance criteria for a repository when no one knows what those criteria will be—or if there will be any repository at all. A few others recommended that the EIS evaluate the PUREX process before it is shut down to ensure that the waste forms resulting from electrometallurgical treatment are as good as the borosilicate glass that is being prepared for a geologic repository.

The commentors generally agreed that DOE should evaluate in detail all of the alternative treatment technologies that potentially could meet DOE's treatment and management needs, even those that DOE considers less technologically mature. Several commentors expressed the opinion that DOE already has made a technology decision in favor of electrometallurgical treatment, but that other alternative new technologies should not be dismissed because of a lack of knowledge about them. Some asked that the EIS: (1) explain how DOE can consider the PUREX process a reasonable alternative when, historically, it could not handle sodium-bonded spent nuclear fuel, and (2) evaluate whether changes in the PUREX process would be needed to accommodate sodium-bonded spent nuclear fuel. A few commentors suggested the EIS should analyze blanket and driver spent nuclear fuel separately, since they have different chemical and radiological characteristics and different treatments might be warranted.

Comments concerning environment, safety, and health issues were comparatively few, as were comments about transportation safety and security.

Comments received during the scoping period were systematically reviewed and evaluated to determine whether the issues raised fell within the scope of the EIS. The comments are addressed in the EIS as indicated in Appendix A, Table A–1, which includes references to specific EIS sections. As a result of public comment, DOE changed the proposed action of the EIS, as well as the structure of the alternatives. The proposed action was changed from electrometallurgical treatment of sodium-bonded spent nuclear fuel in the Fuel Conditioning Facility at ANL-W to the treatment and management of sodium-bonded spent nuclear fuel. The title also was changed accordingly. This change was made to alleviate concerns about bias for one treatment technology over others. The alternatives were restructured to reflect differences in the characteristics of the different types of sodium-bonded spent nuclear fuel. Thus, several alternatives were added that treat driver and blanket spent nuclear fuel by different technologies.

Issues related to cost and nuclear nonproliferation were not considered to be within the scope of the EIS. However, DOE conducted a Cost Study and a Nonproliferation Impacts Assessment for the reasonable alternatives. These reports were made available to the public during the public review process.

With respect to comments related to the ongoing Electrometallurgical Treatment Research and Demonstration Project, data from the project were used for the preparation of both the draft and the final EIS as indicated in Section 1.6.3.

Comments considered to be not within the scope of the EIS are listed in Appendix A, Table A–3, along with an explanation for their disposition.

1.3.2 Issues Raised During the Public Comment Period on the Draft EIS

In July 1999, DOE published the *Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*. The regulations implementing the National Environmental Policy Act (NEPA) mandate a minimum 45-day public comment period after publication of a draft EIS to provide an opportunity for the public and other stakeholders to comment on the EIS analysis and results. The 45-day public comment period on the SBSNF Draft EIS began on July 31, 1999, and was scheduled to end on September 13, 1999. In response to commentor requests, the comment period was extended an additional 15 days through September 28, 1999. During this 60-day comment period, public hearings were held in North Augusta, South Carolina; Boise and Idaho Falls, Idaho; and Arlington, Virginia. In addition, the public was encouraged to submit comments via the U.S. mail service, electronic mail, a toll-free 800-number phone line, and a toll-free fax line.

A total of 494 comments were received during the public comment period. Most of the comments focused on the following issues: (1) the purpose, need for, and timing of the proposed action; (2) the introduction of new waste forms produced by the proposed action, their acceptability in a geologic repository, and the disposition of uranium and plutonium by-products; (3) the public availability of information considered relevant to reviewing the draft EIS, the extension of the comment period, and the relationship of the EIS to other DOE programs; (4) the cost of the various alternatives; (5) the impacts of the proposed action on U.S. nuclear nonproliferation policy; (6) technical or NEPA-related questions regarding technologies and alternatives; and (7) questions related to the affected environment and the environmental consequences. DOE's responses to these issues are summarized below. The comments also dealt with a number of other subjects, including technologies considered and dismissed from further evaluation, long-term (beyond institutional control) performance of the sodium-bonded spent nuclear fuel during storage on site, and questions on the methodology and assumptions of the health and safety analysis. Many commentors expressed their opposition or support for DOE's action in general or for specific alternatives under the proposed action or the No Action Alternative. Section A.2 of Appendix A provides DOE's responses to all comments on a comment-by-comment basis.

Purpose, Need for, and Timing of the Proposed Action

Many comments expressed the opinion that DOE failed to demonstrate the purpose and need for the proposed action or to provide a rationale for its timing. Some of the reasons given included the lack of a compelling argument that there is a safety risk associated with current storage; the lack of a regulatory framework and final waste acceptance criteria; the lack of an approved site for a geologic repository; insufficient information on the results of the Electrometallurgical Treatment Research and Demonstration Project; and the lack of analysis showing that direct disposal of the sodium-bonded spent nuclear fuel without sodium removal would be detrimental to the performance of the geologic repository.

DOE's position, presented in the EIS, is that the need to examine options for the treatment and management of sodium-bonded spent nuclear fuel is based on the existing regulatory environment concerning long-term disposal of spent nuclear fuel and high-level radioactive waste. DOE assumes that its sodium-bonded spent nuclear fuel, as well as other DOE-owned spent nuclear fuel, eventually will be disposed of in a geologic repository. However, one of the key requirements, as specified in the current April 1999 version of DOE's Waste Acceptance Systems Requirements Document (DOE 1999c) and in NRC requirements for acceptance of spent nuclear fuel or high-level radioactive waste in a geologic repository, is that it cannot contain or generate materials that are explosive, pyrophoric, or chemically reactive in a form or amount that could compromise the repository's ability to perform its waste isolation function or to satisfy its performance objective [10 CFR 60.135(b)(1)]. The sodium-bonded spent nuclear fuel, if left in its existing state, would contain pyrophoric and chemically reactive metallic sodium and therefore may not meet DOE or NRC repository acceptance criteria, or would complicate the qualification process.

The timing for the proposed action is a programmatic issue rather than a safety issue. The EIS does not conclude that current storage of sodium-bonded spent nuclear fuel presents a threat to the health and safety of workers or the public. The programmatic risk associated with implementing the proposed action or not treating the sodium-bonded spent nuclear fuel is the uncertainty surrounding the acceptability of this fuel for placement in a geologic repository. The process of establishing a repository is dependent on not only the site but also the materials to be disposed. As part of this process, a total system performance assessment that describes the probable behavior of a repository is performed. This total system assessment includes the performance of the specific waste forms and inventories proposed for disposal. As part of the process of establishing a repository, data for the waste forms are needed prior to making a final repository selection, not after. In fact, if specific waste forms are not represented in crucial documents like this EIS, new documentation will be needed to allow the possibility of disposing of those materials in the repository. The performance of sodium-bonded spent nuclear fuel in a geologic repository depends on many factors (e.g., long-term fuel integrity and fuel/waste package survivability in a repository environment), and the presence of metallic sodium would complicate the modeling even further. Stabilization of the sodium-bonded spent nuclear fuel and/or removal of the metallic sodium would provide greater protection for human health and the environment.

The Electrometallurgical Treatment Research and Demonstration Project began in June 1996 and, although the review of the test results has not been finalized in a single report, a number of status reports were issued by DOE and reviewed by the National Academy of Sciences' National Research Council Committee. They are referenced in the EIS. The success criteria established at the outset of the project have been fulfilled. The environmental impact analysis associated with the electrometallurgical treatment process alternatives was based on actual data from the demonstration project. This final EIS includes a new section on the status and results of the project. Having completed the demonstration project and in considering the future of its PUREX processing capabilities, DOE now needs to decide whether these technologies are suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the NEPA process could result in a loss of capability and of technical staff knowledgeable about and experienced with the demonstration project. This was an important consideration in the decision to proceed with this EIS.

New Waste Forms and Disposition of Uranium and Plutonium By-Products

Some of the comments questioned the generation of new waste forms from treating the sodium-bonded spent nuclear fuel and the possible acceptance of these forms in a geologic repository. Also, a number of commentors remarked on the generation of uranium and plutonium as by-products of the treatment process. Related issues were the disposition of uranium metal, a by-product of the electrometallurgical process, and the compliance of both the PUREX and the electrometallurgical processes with U.S. nuclear nonproliferation policy in terms of the separation of these elements.

All of the alternatives evaluated in this EIS would produce some form of high-level radioactive waste. Electrometallurgical treatment would produce two new waste forms (i.e., metallic and ceramic) and the melt and dilute process would produce a new metallic form (i.e., a melt and dilute product, or conditioned spent nuclear fuel). These forms would be more stable than the untreated sodium-bonded spent nuclear fuel. The production of a chemically stable waste form to replace a chemically reactive waste form (i.e., sodium-bonded spent nuclear fuel) represents an improvement in the safe, long-term storage of this spent nuclear fuel. DOE expects the new waste forms to be suitable for disposal in a repository and to meet the requirements of the final waste acceptance criteria. The high-level radioactive waste form resulting from the PUREX process is borosilicate glass, which has been tested and analyzed extensively under conditions relevant to a geologic repository.

With respect to uranium and plutonium disposition, the EIS states that any uranium that would be separated under the electrometallurgical process would be blended down and stored on site if it originates from driver spent nuclear fuel, or would be stored on site as depleted uranium if it originates from blanket spent nuclear fuel. The final disposition of the stored uranium has not been decided and is not discussed in the EIS. The disposition of the uranium will be subject to a separate NEPA review. The nuclear nonproliferation policy aspects of this separation are subject to the nuclear nonproliferation policy assessment of the alternatives. The approximately 260 kilograms (572 pounds) of plutonium that would be separated under the PUREX process would be disposed of in accordance with the Record of Decision (65 FR 1608) for the *Surplus Plutonium Disposition Final Environmental Impact Statement* (DOE 1999e) issued in November 1999. This separation is the subject of the Nonproliferation Impacts Assessment, which is independent of this EIS.

Public Availability of Information and Related Documentation

Many commentors asked for a 60-day extension of the 45-day public comment period on the draft EIS. Commentors said they wanted additional time to obtain and review relevant documents such as the Yucca Mountain Draft EIS and the National Academy of Sciences' National Research Council's final report on the Electrometallurgical Treatment Research and Demonstration Project, as well as the Cost Study and the Nonproliferation Impacts Assessment. The comments frequently stated that DOE needs to make all of this information publicly available before the end of the EIS comment period and the issuance of the final EIS and the Record of Decision.

In an effort to ensure that all interested parties had time to comment on the draft EIS, the due date for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169). With respect to the need for more information, DOE made that information available to the public. Background materials were placed in public reading rooms and were made available to the public through a series of hearings held August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho; and August 31, 1999, in Arlington, Virginia. Materials placed in the reading rooms included the electrometallurgical demonstration environmental assessment, the Finding of No Significant Impact for the environmental assessment, National Research Council reports, the 1995 Settlement Agreement and Consent Order with the State of Idaho, the scoping meeting transcripts and comments, and the draft EIS hearing presentations and fact sheets. In addition, completion of the Cost Study and Nonproliferation Impacts Assessment was expedited so that they would be available to the public during the comment period. These reports were mailed to interested parties on August 12, 1999, and were made available to attendees at all of the public hearings on the draft EIS. Although these reports are not critical to the evaluation of the analysis presented in the draft EIS, they will provide input to the Record of Decision. While the final National Research Council report on the demonstration project was published in April 2000, interim status reports were produced throughout the project. Data generated during the demonstration project were used in preparing the EIS.

Cost Issues

A number of commentors raised cost issues and provided comments directly related to the Cost Study, which is not part of the EIS.

Comments concerning the costs of the proposed action were considered beyond the scope of the EIS. The EIS was prepared in accordance with NEPA, as well as the Council on Environmental Quality's regulations on implementing NEPA (40 CFR 1500 through 1508) and DOE's NEPA regulations (10 CFR 1021). None of these regulations require the inclusion of a cost analysis in an EIS. The basic objective of the SBSNF EIS is to provide the public and DOE decision-makers with a description of the reasonable alternatives for treating and managing sodium-bonded spent nuclear fuel and information about their potential impacts on

public health and safety and the environment. While cost could be an important factor in the ultimate Record of Decision, the purpose of this EIS is to address the environmental consequences of all alternatives under the proposed action and the No Action Alternative. DOE distributed cost information through the independent Cost Study released in August 1999, and this information is available to the public on request and in the DOE public reading rooms. Responses to specific comments related to cost issues are included in Section A.2 of Appendix A.

Nuclear Nonproliferation Policy Issues

The nuclear nonproliferation implications of the proposed action were the subject of a number of comments. Some commentors expressed strong opinions about how the use of specific technologies such as electrometallurgical treatment might impact U.S. nonproliferation policy.

Nonproliferation is another issue that was considered beyond the scope of the EIS. A separate Nonproliferation Impacts Assessment was prepared by DOE's Office of Arms Control and Nonproliferation. After assessing the potential nonproliferation impacts that could result from each of the alternatives and technologies analyzed in the SBSNF Draft EIS, the Office of Arms Control and Nonproliferation found that all the alternatives, except that involving PUREX processing at SRS, are fully consistent with U.S. policy concerning reprocessing and nuclear nonproliferation. Electrometallurgical treatment, for example, would not increase national inventories of weapons-usable fissile material because, although highly enriched uranium is an interim product of the process, it would be blended down to low-enriched uranium during treatment. Within the current equipment configuration and design, it is not possible to produce weapons-usable plutonium merely by adjusting the operating parameters. To do this, traditional aqueous processing would be required after electrometallurgical treatment. However, traditional aqueous processing could be used to produce weapons-usable plutonium directly from the spent nuclear fuel, without electrometallurgical treatment, so electrometallurgical treatment itself does not present a special proliferation concern. Responses to specific comments related to nonproliferation are included in Section A.2 of Appendix A.

Technologies, Alternatives

Various comments dealt with technical questions and issues regarding the treatment technologies addressed in the EIS or NEPA-related issues regarding the selected alternatives.

The variety of the issues precludes a summary response. Responses to these questions on a comment-by-comment basis are included in Section A.2 of Appendix A. A number of revisions to the EIS were made as a result of these comments.

Affected Environment and Consequences

A number of comments included questions concerning the description of the affected environment in the SBSNF Draft EIS, and the results of the environmental impact analysis.

As in the case above, responses to these questions on a comment-by-comment basis are included in Section A.2 of Appendix A.

1.4 SCOPE OF THIS EIS

The EIS evaluates the potential direct, indirect, and cumulative environmental impacts associated with the treatment of sodium-bonded spent nuclear fuel in one or more spent nuclear fuel management facilities. In addition, this EIS evaluates the environmental impacts of the No Action Alternative.

DOE proposes to treat and manage sodium-bonded spent nuclear fuel at one or more of the following spent nuclear fuel management facilities: ANL-W at INEEL and the F-Canyon or Building 105-L at SRS. The impacts from the treatment and management of sodium-bonded spent nuclear fuel at INEEL and SRS and their spent nuclear fuel management facilities are described in this EIS. In addition to the No Action Alternative, the EIS analyzes six reasonable alternatives under the proposed action that employ one or more of the following technology options: electrometallurgical treatment, the PUREX process, packaging in high-integrity cans, and the melt and dilute treatment process. Electrometallurgical treatment at a site other than ANL-W, the GMODS process, the direct plasma arc-vitreous ceramic treatment, and the chloride volatility process were considered and deemed not to be reasonable alternatives under the proposed action.

This EIS analyzes the potential environmental impacts associated with the proposed action, which includes: (1) preparation prior to treatment; (2) treatment and management; (3) transportation; and (4) decontamination and deactivation of equipment that would be installed for the purpose of implementing a specific treatment method. Impacts from the transport to INEEL of sodium-bonded spent nuclear fuel from DOE sites such as the Hanford site in Washington, Sandia National Laboratories in New Mexico, and Oak Ridge National Laboratory in Tennessee are addressed in the Programmatic Spent Nuclear Fuel EIS (DOE 1995a).

The United States does not encourage the civilian use of plutonium and, accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes. However, two of the technologies under the proposed action involve the separation of plutonium (PUREX) and highly enriched uranium (electrometallurgical treatment). To address concerns that treatment of this fuel by chemical separation could encourage reprocessing in other countries, DOE's Office of Nonproliferation and National Security independently evaluated the impacts of each treatment technology on U.S. nonproliferation efforts. The Nonproliferation Impacts Assessment was published at about the same time as the draft EIS.

1.5 DECISIONS TO BE MADE

Based on the analytical results of this EIS as well as cost, schedule, and nonproliferation considerations, DOE intends to make the following decisions:

- Whether to use an existing, mature technology to treat the sodium-bonded spent nuclear fuel, and if so, which technology should be selected and where it should be implemented.

- Whether to take no action now and wait for further information regarding the potential development of a geologic repository, or promote the development of a less mature or new treatment technology.

The information presented in this EIS, combined with public comments on the draft EIS, the Nonproliferation Impacts Assessment, a Cost Study of the reasonable alternatives, and the National Research Council's final evaluation of the demonstration project, will enable DOE to make a decision regarding treatment and management of the sodium-bonded spent nuclear fuel.

1.6 RELATIONSHIP TO OTHER ACTIONS AND PROGRAMS

This section explains the relationship between this EIS and other relevant NEPA documents and programs. Completed NEPA actions are described in Section 1.6.1, ongoing actions are described in Section 1.6.2, and the Electrometallurgical Treatment Research and Demonstration Project is described in Section 1.6.3.

1.6.1 Completed NEPA Actions

1.6.1.1 Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement

This Programmatic Spent Nuclear Fuel EIS (DOE 1995a) analyzed at a programmatic level the potential environmental consequences of alternatives used for 40 years to transport, receive, process, and store spent nuclear fuel under DOE's responsibility. It also analyzed the consequences of 10 years of waste and spent nuclear fuel management and environmental restoration actions at Idaho National Engineering Laboratory (now known as INEEL). For programmatic spent nuclear fuel management, this document analyzed alternatives that included no action, decentralization, regionalization, centralization, and the use of plans that existed in 1992 and 1993 for the management of these materials. For the INEEL, this document analyzed alternatives such as no action, a 10-year plan, and minimum and maximum treatment, storage, and disposal of DOE waste.

Issued in April 1995, the Programmatic Spent Nuclear Fuel EIS was followed by a Record of Decision published in the *Federal Register* on June 1, 1995 (60 FR 28680). In the Record of Decision, DOE decided to regionalize spent nuclear fuel management by fuel type for DOE-owned spent nuclear fuel. DOE also decided to: (1) continue environmental restoration activities at the INEEL; (2) develop cost-effective treatment technologies for spent nuclear fuel and waste management; and (3) implement projects and facilities to prepare waste and treat spent nuclear fuel for interim storage and final disposition. The SBSNF EIS was prepared as a follow-on to this programmatic EIS.

The June 1, 1995, Record of Decision was later amended to reflect the October 16, 1995, Settlement Agreement and Consent Order between DOE, the State of Idaho, and the U.S. Department of the Navy pertaining to spent nuclear fuel shipments into and out of the State of Idaho. The amendment to the Record of Decision was published in the *Federal Register* on March 8, 1996 (61 FR 9441). In this amendment, DOE did not modify or rescind any of the provisions presented in the June 1, 1995, Record of Decision (60 FR 28680), but reduced the number of shipments of spent nuclear fuel into the State of Idaho.

1.6.1.2 Savannah River Site Waste Management Final Environmental Impact Statement

DOE issued this EIS (DOE 1995b) to provide a basis for the selection of a site-wide approach to managing present and future (through 2024) waste generated at SRS. This waste would come from ongoing operations and potential actions, new missions, environmental restoration, and decontamination and decommissioning programs.

The SRS Waste Management EIS includes the treatment of wastewater discharges in the Effluent Treatment Facility, F- and H-Area tank operations and waste removal, and construction and operation of a replacement high-level radioactive waste evaporator in the H-Area tank farm. In addition, it evaluates the Consolidated Incineration Facility for the treatment of mixed waste. The Record of Decision, published in the *Federal Register* on October 30, 1995 (60 FR 55249), stated that DOE will configure its waste management system according to the moderate treatment alternative described in the EIS. The SRS Waste Management EIS evaluates management alternatives for various types of waste that actions proposed in this EIS could generate.

In a Supplemental Record of Decision published in the *Federal Register* on May 19, 1997 (62 FR 27241), DOE decided to take additional measures to further implement the Moderate Treatment Configuration Alternative for mixed waste and transuranic waste. This decision was based on the SRS Waste Management EIS and was consistent with completed negotiations between DOE and the State of South Carolina.

1.6.1.3 Final Environmental Impact Statement, Interim Management of Nuclear Materials

In this EIS (DOE 1995c) DOE evaluated actions to stabilize nuclear materials at SRS that present potential environmental, safety, and health risks in their current storage condition or may present a risk within the next 10 years. As a result, DOE published five decisions from this EIS. In the Record of Decision, published in the *Federal Register* on December 19, 1995 (60 FR 65300), DOE decided to process, blend, and/or vitrify specific amounts of plutonium, uranium, americium, and curium solutions, and spent nuclear fuel down to low enrichments and/or some other form of stable material. The Savannah River Site Interim Management of Nuclear Materials EIS evaluates the treatment and management of spent nuclear fuel and other waste at SRS such as those generated by the proposed actions in the SBSNF EIS.

In the first, second, and third supplements to the Record of Decision, published in the *Federal Register* on February 21, 1996; September 13, 1996; and April 11, 1997, respectively (61 FR 6633, 61 FR 48474, and 62 FR 17790), DOE decided to stabilize additional amounts of spent nuclear fuel and other materials by processing them in the F-Canyon, H-Canyon, and the FB-Line and blending the resulting highly enriched uranium down to low-enriched uranium. DOE then would transfer the resulting nuclear material to the SRS high-level radioactive waste tanks for vitrification in the Defense Waste Processing Facility.

In the fourth supplement to the Record of Decision, published in the *Federal Register* on November 14, 1997 (62 FR 61099), DOE decided to process, store, and vitrify specific amounts of nuclear material in the Defense Waste Processing Facility and to amend the September 13, 1996, supplement to the Record of Decision (61 FR 48474) to address additional amounts of plutonium and neptunium solutions stored at SRS.

1.6.1.4 Environmental Assessment for the Electrometallurgical Treatment Research and Demonstration Project in the Fuel Conditioning Facility at Argonne National Laboratory-West

This NEPA analysis (DOE 1996a) addressed the environmental impacts associated with a research and demonstration project involving the electrometallurgical treatment of up to 100 EBR-II driver spent nuclear fuel assemblies and up to 25 EBR-II blanket spent nuclear fuel assemblies in the Fuel Conditioning Facility at ANL-W. As noted in the environmental assessment, DOE had identified electrometallurgical treatment as a promising technology to treat EBR-II spent nuclear fuel, but an appropriate demonstration was needed to provide DOE with sufficient information to evaluate its technical feasibility. A successful demonstration of the electrometallurgical treatment technology on EBR-II spent nuclear fuel, combined with research and testing of the resulting waste forms, would provide DOE with the information needed to determine whether this treatment technology should be used to treat the remainder of EBR-II spent nuclear fuel and/or other types of spent nuclear fuel. Based on the analysis presented in the environmental assessment, and after consideration of all the comments received from the public, DOE decided to proceed with the proposed demonstration and finalized the environmental assessment on May 15, 1995. DOE also determined that the proposed action did not constitute a major Federal action and would not necessitate the preparation of an EIS. DOE issued a Finding of No Significant Impact, which was published in the *Federal Register* on May 22, 1996 (61 FR 25647).

The electrometallurgical treatment process that was addressed in this environmental assessment is basically the same process that is being evaluated in this EIS. The process involves the dissolution of spent nuclear fuel by the use of an electric current in a molten salt mixture. The only difference between the environmental assessment and this SBSNF EIS is the amount of spent nuclear fuel being considered for treatment.

The Electrometallurgical Treatment Research and Demonstration Project was completed in August 1999. Salient features of the project and results are discussed in Section 1.6.3.

1.6.1.5 Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement

DOE prepared this EIS (DOE 1996b) because of the need to move rapidly to neutralize the proliferation threat of surplus highly enriched uranium and to demonstrate to other nations the United States' commitment to nonproliferation. The Highly Enriched Uranium EIS evaluates management alternatives for materials that actions proposed in this EIS could generate.

In the Record of Decision, published in the *Federal Register* on August 5, 1996 (61 FR 40619), DOE stated it would implement a program that will gradually blend as much as 85 percent of the surplus highly enriched uranium to a uranium-235 enrichment level of approximately 4 percent, and will blend the remaining surplus highly enriched uranium down to an enrichment level of about 0.9 percent for disposal as low-level radioactive waste. This will occur over 15 to 20 years. DOE could use different technologies at four potential blending facilities, including SRS and the Oak Ridge Reservation. Blending down highly enriched uranium would affect SRS operations and waste generation.

1.6.1.6 Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste

This Final Waste Management Programmatic EIS (DOE 1997) examined the potential environmental and cost impacts of strategic management alternatives for managing five types of radioactive and hazardous waste that have resulted and will continue to result from nuclear defense and research activities at a variety of sites around the United States. The five waste types are mixed waste, low-level radioactive waste, transuranic waste, high-level radioactive waste, and hazardous waste. This programmatic EIS provided information on the impacts of various siting alternatives which DOE will use to decide at which sites to locate additional treatment, storage, and disposal capacity for each waste type. This information included the cumulative impacts of combining future siting configurations for the five waste types and the collective impacts of other past, present, and reasonably foreseeable future activities. The programmatic EIS evaluates management and treatment alternatives for various types of waste that actions proposed in this EIS could generate.

The waste management facilities considered for the five waste types were treatment and disposal facilities for mixed waste; treatment and disposal facilities for low-level radioactive waste; treatment and storage facilities for transuranic waste in the event that treatment is required before disposal; storage facilities for treated (vitrified) high-level radioactive waste canisters; and treatment of nonwastewater hazardous waste by DOE and commercial vendors. In addition to the No Action Alternative, which included only existing or approved waste management facilities, the alternatives for each of the five waste type configurations included decentralized, regionalized, and centralized alternatives for operating existing and new waste management facilities. However, the siting, construction, and operation of any new facility at a selected site would not be decided until completion of a site-wide or project-specific environmental review.

DOE has published four decisions from this programmatic EIS. In the first Record of Decision, published in the *Federal Register* on January 23, 1998 (63 FR 3629), DOE decided that each DOE site that currently has or will generate transuranic waste will prepare and store its transuranic waste on site, except for Sandia National Laboratories/New Mexico, which will transfer its transuranic waste to the Los Alamos National Laboratory. Los Alamos National Laboratory will have facilities that are not available or anticipated at Sandia National Laboratories to prepare and store transuranic waste prior to disposal.

In the second Record of Decision, published in the *Federal Register* on August 5, 1998 (63 FR 41810), DOE decided to continue using offsite facilities for the treatment of major portions of the nonwastewater hazardous waste generated at DOE sites. This decision did not involve any transfer of nonwastewater hazardous waste among DOE sites.

In the third Record of Decision, published in the *Federal Register* on August 26, 1999 (64 FR 46661), DOE decided to store immobilized high-level radioactive waste in a final form at the site of generation (Hanford, INEEL, SRS, and the West Valley Demonstration Project) until transfer to a geologic repository for ultimate disposal.

DOE addressed the management and disposal of low-level and mixed radioactive waste in a fourth Record of Decision, published in the *Federal Register* on February 25, 2000 (65 FR 10061). In this Record of Decision, DOE decided to perform minimum treatment of low-level radioactive waste at all sites and continue, to the extent practicable, disposal of onsite low-level radioactive waste at INEEL, Los Alamos National Laboratory, the Oak Ridge Reservation, and SRS. DOE decided to treat mixed low-level radioactive waste at the Hanford site, INEEL, the Oak Ridge Reservation, and SRS, with disposal at the Hanford site and the Nevada Test Site.

1.6.1.7 Advanced Mixed Waste Treatment Project Final Environmental Impact Statement

This EIS (DOE 1999a) assessed the potential environmental impacts associated with four alternatives related to the construction and operation of the Advanced Mixed Waste Treatment Facility at INEEL. The alternatives analyzed were: the No Action Alternative; the proposed action; the Nonthermal Treatment Alternative; and the Treatment and Storage Alternative. The Advanced Mixed Waste Treatment Facility would treat transuranic waste, mixed waste, and alpha-contaminated mixed waste in preparation for disposal. After treatment, transuranic waste would be disposed of at the Waste Isolation Pilot Plant in New Mexico. Mixed waste would be disposed of at an approved disposal facility depending on decisions to be based on DOE's Final Waste Management Programmatic EIS (DOE 1997). Evaluations of impacts on land use; socioeconomics; cultural resources; aesthetic and scenic resources; geology; air resources; water resources; ecological resources; noise; traffic and transportation; occupational and public health and safety; INEEL services; and environmental justice were included in the assessment. The *Advanced Mixed Waste Treatment Project Final Environmental Impact Statement* addresses waste types that could be generated by actions proposed in this EIS.

In the Record of Decision, published in the *Federal Register* on April 7, 1999 (66 FR 16948), DOE decided to proceed with the construction and operation of the Advanced Mixed Waste Treatment Facility. DOE then will treat and prepare for shipment and disposal 65,000 cubic meters (2.3 million cubic feet) of DOE transuranic waste, mixed waste, alpha-contaminated mixed waste currently stored at INEEL. As a result of the decision to complete this facility, DOE also could treat up to 120,000 cubic meters (4.24 million cubic feet) of additional waste from INEEL or other DOE sites for a total of 185,000 cubic meters (6.53 million cubic feet). The Advanced Mixed Waste Treatment Facility will treat waste to meet the Waste Isolation Pilot Plant Waste Acceptance Criteria and applicable requirements of the Toxic Substances Control Act and the Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions.

In makings its decision, DOE considered several factors, including the environmental analyses reported in the Advanced Mixed Waste Treatment Project Final EIS; estimated costs of the alternatives reported in the Advanced Mixed Waste Treatment Project EIS Alternatives Cost Study; regulatory implications of the alternatives; mission; national policy; and public comments on the Advanced Mixed Waste Treatment Project Draft EIS. This Record of Decision (66 FR 16948) documents DOE's decision to implement the Preferred Alternative, which provides the greatest long-term protection of the environment with small short-term environmental impacts and health risks.

1.6.1.8 Surplus Plutonium Disposition Final Environmental Impact Statement

The Surplus Plutonium Disposition EIS (DOE 1999e) was tiered from the *Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement* (DOE 1996c). The Record of Decision for the programmatic EIS, published in the *Federal Register* on January 14, 1997

(62 FR 3014), outlined DOE's approach to plutonium disposition and established the groundwork for the Surplus Plutonium Disposition EIS. The fundamental purpose of the program is to ensure that plutonium produced for nuclear weapons and declared excess to national security needs (now and in the future) will never again be used for nuclear weapons.

The Surplus Plutonium Disposition EIS evaluated reasonable alternatives for the siting, construction, and operation of facilities required to implement DOE's disposition strategy for up to 50 metric tons of surplus plutonium, including a No Action Alternative. The disposition facilities analyzed in this EIS include pit disassembly and conversion, plutonium conversion and immobilization, and mixed oxide fuel fabrication. The Surplus Plutonium Disposition EIS also analyzed the potential impacts of fabricating a limited number of mixed oxide fuel assemblies for testing in a reactor. The Surplus Plutonium Disposition EIS is a related NEPA action because it addresses the disposition of material that the SBSNF EIS could generate.

In the Record of Decision, published in the *Federal Register* on January 11, 2000 (65 FR 1608), DOE decided to provide for the safe and secure disposition of up to 50 metric tons of surplus plutonium by constructing all three disposition facilities, pit disassembly and conversion, plutonium conversion and immobilization, and mixed oxide fuel fabrication, at SRS. DOE also decided to implement the mixed oxide fuel alternative analyzed in the EIS.

1.6.2 Ongoing NEPA Actions

1.6.2.1 Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement

The *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement* (DOE 2000) was issued in March 2000. This SRS Spent Nuclear Fuel Final EIS analyzed the potential impacts from the management of spent nuclear fuel and targets assigned to SRS, including placing these materials in forms suitable for ultimate disposition. Options to treat, package, and store spent nuclear fuel are discussed in this document. The material addressed by this EIS consists of approximately 68 metric tons of heavy metal of spent nuclear fuel (including 20 metric tons of heavy metal of uranium-thorium spent nuclear fuel at SRS; approximately 28 metric tons of heavy metal of aluminum-clad spent nuclear fuel from foreign and domestic research reactors to be shipped to SRS through 2035; and 20 metric tons of heavy metal of stainless steel or zirconium-clad spent nuclear fuel, as well as some other programmatic material stored at SRS for repackaging and dry storage pending shipment off site).

The alternatives considered in the SRS Spent Nuclear Fuel Final EIS encompass a range of new packaging, new processing, and conventional reprocessing technologies for the treatment of spent nuclear fuel. Many of these technologies also are analyzed in this SBSNF EIS. However, in the SRS Spent Nuclear Fuel Final EIS, DOE chose melt and dilute and conventional processing (PUREX) as preferred treatment alternatives for the spent nuclear fuel assigned to SRS.

1.6.2.2 Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada

This draft EIS (DOE 1999b) assesses the potential environmental impacts from the proposed construction, operation, monitoring, and closure of an NRC-licensed geologic repository for the disposal of spent nuclear fuel and high-level radioactive waste, as mandated by the Nuclear Waste Policy Act, as amended. The Yucca Mountain EIS is required to accompany any DOE site recommendation to the President, as appropriate, under Section 114 of the Nuclear Waste Policy Act.

The proposed action addressed in this EIS is to construct, operate and monitor, and eventually close a geologic repository at Yucca Mountain in southern Nevada for the disposal of spent nuclear fuel and high-

level radioactive waste currently in storage at 72 commercial and 5 DOE sites across the United States. The EIS evaluates (1) projected impacts on the Yucca Mountain environment from the construction, operation and monitoring, and eventual closure of the geologic repository; (2) the potential long-term impacts of repository disposal of spent nuclear fuel and high-level radioactive waste; (3) the potential impacts of transporting these materials nationally and in the state of Nevada; and (4) the potential impacts of not proceeding with the proposed action. Included in the high-level radioactive waste that is assumed to be disposed of at the repository are the metallic and ceramic waste forms that would be produced by the electrometallurgical treatment of both driver and blanket sodium-bonded spent nuclear fuel.

Under the No Action Alternative, the EIS evaluates the potential impacts of the continued storage of spent nuclear fuel and high-level radioactive waste at the current storage locations using two scenarios: the first assumes continued storage under institutional controls for at least 10,000 years, and the second assumes no institutional controls after 100 years.

The SBSNF EIS considers the potential disposal at a geologic repository of spent nuclear fuel or high-level radioactive waste that may result from the proposed action involving sodium-bonded spent nuclear fuel. The Yucca Mountain Draft EIS includes the potential long-term impacts of repository disposal from electrometallurgically treated sodium-bonded spent nuclear fuel using data presented in the SBSNF Draft EIS. Quantities of radioactive waste analyzed in the Yucca Mountain document were based on previous projections that have been updated in this document.

1.6.2.3 Idaho High-Level Waste and Facilities Disposition Draft Environmental Impact Statement

This draft EIS was issued in December 1999 (DOE 1999d). It evaluates alternatives for managing the high-level radioactive waste and associated radioactive waste and facilities at INEEL. Under the terms of the 1995 Settlement Agreement and Consent Order with the State of Idaho, DOE agreed to treat high-level radioactive waste currently stored at INEEL and to prepare the waste in a form ready to be shipped out of the State of Idaho by 2035. The purpose of this EIS is to assist DOE in making decisions concerning the management of this radioactive waste to ensure compliance with applicable laws and regulations, and protect the environment and the health and safety of the workers and the public in a cost-effective manner. The high-level radioactive waste generated by the treatment and management of sodium-bonded spent nuclear fuel at ANL-W would not require any additional treatment at INEEL and is not evaluated in the Idaho High-Level Waste EIS.

In this EIS, DOE evaluates reasonable alternatives and options for the treatment of high-level radioactive waste, sodium-bearing waste, newly generated waste, and the disposition of facilities associated with high-level radioactive waste generation, treatment, and storage at INEEL. In addition, this EIS is integrated with the ongoing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program at the Idaho Nuclear Technology and Engineering Center. The proposed action under this EIS contributes to the cumulative impacts at the site discussed in the SBSNF EIS.

1.6.3 Electrometallurgical Treatment Research and Demonstration Project

Before electrometallurgical treatment could be considered as a technology choice for treating EBR-II spent nuclear fuel, an appropriate demonstration project was needed to evaluate its technical feasibility. As a preliminary step to demonstration, DOE requested that the National Academy of Sciences' National Research Council conduct an independent assessment of electrometallurgical treatment technology and its potential application to EBR-II spent nuclear fuel. In its report, published in 1995, the National Research Council recommended DOE proceed with demonstrating the technical feasibility of electrometallurgical treatment using a fraction of the EBR-II spent nuclear fuel. Following the National Research Council's recommendation, DOE conducted an environmental assessment of the demonstration project. The environmental assessment was

completed in May 1996 and resulted in a Finding of No Significant Impact, so that no further NEPA review was necessary for the demonstration project to proceed (Benedict et al. 1999).

In June 1996, DOE initiated a three-year testing program at ANL-W to demonstrate the technical feasibility of electrometallurgical treatment of up to 100 EBR-II driver spent nuclear fuel assemblies and up to 25 depleted uranium EBR-II blanket spent nuclear fuel assemblies. These two types of EBR-II spent nuclear fuel, driver and blanket, are typical of most of DOE's sodium-bonded spent nuclear fuel inventory (Benedict et al. 1999). The number of driver spent nuclear fuel assemblies was selected to provide the minimum fission product loading (approximately 3 percent) needed to evaluate the effectiveness of the removal of fission products from the electrorefiner salt and their concentration in the ceramic waste form. The blanket spent nuclear fuel assemblies were treated using a high-throughput electrorefiner that was installed in ANL-W's Fuel Conditioning Facility to evaluate higher-efficiency electrorefining (DOE 1996a).

A total of 100 driver spent nuclear fuel assemblies were treated. These assemblies required multiple batch operations of the treatment equipment in a remote, radioactive hot cell with an inert argon atmosphere. These operations were considered sufficient to demonstrate a dependable, predictable process, including uptime, repair and maintenance, and the operability of the linked process steps. A repeatability demonstration was completed by processing 12 driver spent nuclear fuel assemblies under the same processing conditions. In addition, processing 100 driver spent nuclear fuel assemblies dissolved sufficient active fission products in the electrorefiner salt so that ceramic waste form samples could be produced with representative waste loadings. The purpose of including blanket spent nuclear fuel assemblies in the test program was to demonstrate the mass throughput capacity of the process equipment and facility. A one-month throughput test was completed and a total of 13 blanket spent nuclear fuel assemblies were treated by the end of August 1999, when the demonstration project was concluded (Benedict et al. 1999).

To support the Electrometallurgical Treatment Research and Demonstration Project, DOE established an extensive research and development program at Argonne National Laboratory-East. The largest element of this research and development program involved development, testing, and qualification of the ceramic waste form. Another element was experimental support for electrorefining and metal processing operations in the Fuel Conditioning Facility. In addition, the research and development program included a modeling activity aimed at understanding and improving the electrometallurgical treatment process as well as laying out the requirements for production-scale treatment of the remaining EBR-II spent nuclear fuel. The combined results of the research and development program at Argonne National Laboratory-East and the spent fuel treatment operations at ANL-W provided the technical basis for final evaluation of the electrometallurgical treatment process. An extensive series of topical reports was prepared to present the results of the demonstration in detail. These reports were the basis for ANL-W's summary report on the demonstration project (Benedict et al. 1999).

To assist in monitoring the progress of the demonstration project, DOE requested that the National Research Council establish a review committee, the Committee on Electrometallurgical Techniques for DOE Spent Fuel Treatment, to evaluate the technology and its development. Working with DOE and the National Research Council committee, ANL-W established four criteria for evaluating the demonstration. The evaluation criteria for the electrometallurgical spent fuel demonstration project are listed below (Benedict et al. 1999).

Criterion 1: *Demonstrate that 100 driver and up to 25 blanket EBR-II assemblies can be treated in a Fuel Conditioning Facility within three years, with a throughput rate of 16 kilograms per month for driver assemblies sustained for a minimum of three months, and a blanket spent nuclear fuel throughput rate of 150 kilograms per month sustained for one month.*

Criterion 2: *Quantification (for both composition and mass) of recycle, waste, and product streams that demonstrate projected material balance with no significant deviations.*

Criterion 3: Demonstrate an overall dependable and predictable process considering uptime, repair and maintenance, and operability of the linked process steps.

Criterion 4: Demonstrate that safety risks, environmental impacts, and nuclear materials accountancy are quantified and acceptable within regulatory limits.

Based on a comparison of the demonstration results with the above criteria for success, the demonstration project was a technical success. All key performance criteria were met or exceeded. The results of the demonstration project proved the technical feasibility of using electrometallurgical treatment technology to process DOE's inventory of sodium-bonded spent nuclear fuel. In addition, the demonstration project validated the throughput rate of the sodium-bonded spent nuclear fuel, quantified all process streams, fine-tuned the operational parameters, refined the electrometallurgical treatment equipment, and provided actual waste forms for characterization. This last accomplishment was of particular importance because, as the Defense Waste Vitrification Project at SRS has shown, waste characterization is a lengthy process. Waste forms must be subjected to detailed chemical analysis and long periods of exposure to expected repository conditions. The waste form characterization in the electrometallurgical treatment demonstration project has already initiated the waste acceptance process. Preliminary results of waste form testing indicate that both the metal and ceramic waste forms produced by the electrometallurgical process appear to be comparable to borosilicate glass, which has been tested and analyzed extensively under conditions relevant to a geologic repository.

The review committee of the National Academy of Sciences' National Research Council has continuously reviewed the progress of the Electrometallurgical Treatment Research and Demonstration Project and all reports to date have found the process to be proven for treating sodium-bonded spent nuclear fuel (Benedict et al. 1999).

In the most recent status report issued in the summer of 1999 (NAS 1999), the National Research Council Committee expressed some concerns about the long-term performance and potential releases from the waste forms under repository conditions. However, as noted above, work completed at ANL-W since the latest National Research Council review of the project indicates that both the ceramic and metallic electrometallurgical treatment waste forms would be comparable to borosilicate glass, which has been tested extensively under conditions relevant to the repository. The final report from the National Research Council Committee was published in April 2000. The National Research Council's final report on *Electrometallurgical Techniques for DOE Spent Fuel Treatment* concluded that "The EBR-II demonstration project has shown that the electrometallurgical technique can be used to treat sodium-bonded spent nuclear fuel." The report further stated that "The committee has found no significant technical barriers in the use of electrometallurgical technology to treat EBR-II spent fuel, and EMT [electrometallurgical treatment] therefore represents a potentially viable technology for DOE spent nuclear fuel treatment." DOE will consider the Council's final report during the Record of Decision process which follows the issuance of the final EIS.

1.7 CHANGES FROM THE DRAFT EIS

In response to comments on the SBSNF Draft EIS and as a result of information that was unavailable at the time of the draft EIS issuance, the final EIS contains revisions and new information. These revisions and new information are indicated by a double underline for minor word changes or by a sidebar in the margin for sentence or larger additions. Appendix A contains the comments received during the public review period of the SBSNF Draft EIS and DOE's responses to these comments. Responses to comments related to cost and nuclear nonproliferation issues, although included in the Appendix, did not result in any changes to the EIS. A brief discussion of the most important changes included in the final EIS is provided in the following paragraphs.

Results of the Electrometallurgical Treatment Research and Demonstration Project

As a result of public concern that results of the demonstration project were not incorporated in the draft EIS, a section (Section 1.6.3) was added in the final EIS with a description, status, and results of the demonstration project.

Justification of Purpose and Need and Timing

As a result of public concern that the draft EIS did not adequately justify the need and timing for the proposed action, Section 1.2 was revised to reflect DOE's position and DOE's responses to the related comments.

Relationship to Other NEPA Actions

The final EIS was revised to update the information provided on the *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada,* which was issued in July 1999 (DOE 1999b).

Sodium Removal and Disposition

As a result of public comment, the description of an alternate method for decladding and cleaning sodium-bonded blanket spent nuclear fuel, the laser declad and alcohol wash process, was added in Section 2.3.9. The reason the process was not included in the evaluation of the reasonable alternatives also is included in Section 2.3.9.

No Action Alternative Definition

One of the two options of the No Action Alternative was revised from "indefinite" storage until the development of a currently less mature technology to "continued storage of the sodium-bonded spent nuclear fuel until 2035 or until the development of a currently less mature technology." The revision clarifies the issue raised by public comments concerning the time period covered by this EIS. This EIS covers the time period until 2035.

In addition, under both options of the No Action Alternative, it was determined that the sodium-bonded spent nuclear fuel would be packaged at ANL-W in preparation for shipment out of the State of Idaho by 2035.

No Action Alternative Assumptions

As a result of public comment, the assumption for the calculation of the radiological gaseous emissions under the No Action Alternative was changed. The draft EIS conservatively assumed that the radiological gaseous emissions would be a fraction of the total radiological gaseous emissions presented in the Programmatic Spent Nuclear Fuel EIS, in direct proportion to the heavy metal mass ratio of the sodium-bonded spent nuclear fuel to the total spent nuclear fuel stored at INEEL. The final EIS directly calculates the radiological gaseous emissions using a more realistic fuel degradation assumption based on historical evidence. This change considerably reduced the estimated radiological gaseous emissions as well as the resulting doses to workers and the public under the No Action Alternative.

Dose and Risk Calculations

As a result of public comments and the availability of recent data from the Electrometallurgical Treatment Research and Demonstration Project and the *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement* (DOE 2000), dose calculations were revised in the final EIS. These

revisions include: (1) the addition of project total doses to workers, (2) the project total risk to the public under normal operations, and (3) changes in doses and risks to the public and workers from accidents. In addition, dose and risk values were rounded, resulting in some changes in the numerical values in the EIS.

Air Quality

Based on public comments on the draft EIS, concentrations and emissions from sources that operate in support of the processing alternatives at ANL-W (e.g., emergency generators) were quantified and added to Sections 3.2.3 and 3.3.3 (Air Quality and Noise) and Chapter 4 of the final EIS. In addition, the baseline nonradiological air quality concentrations for INEEL presented in the draft EIS were replaced with more current emission inventory data.

Land Use/Ecology

As a result of comments received on the draft EIS, reference to the newly established 29,950-hectare (74,000-acre) INEEL Sagebrush Steppe Ecosystem Reserve was added to Sections 3.2.1.1 (Land Use) and 3.2.6 (Ecological Resources) of the final EIS.

Water Quality

As a result of public comments, a discussion and a summary table of radioactive liquid effluent at both INEEL and SRS were added to Sections 3.2.4 and 3.3.4 (Water Resources) of the final EIS.

Geology and Soils

As a result of public comments on the draft EIS, material on earthquake activity and volcanism in the vicinity of INEEL (Section 3.2.5, Geology and Soils) was revised.

Existing Human Health Risk

As a result of public comments, baseline concentrations and associated hazard indexes or cancer risks for hazardous chemicals at both ANL-W and SRS were added to Sections 3.2.10 and 3.3.10 (Existing Human Health Risk) of the final EIS.

Waste Management

Records of Decision for the Final Waste Management Programmatic EIS (DOE 1997) addressing the management of high-level radioactive waste and low-level and mixed low-level radioactive waste were issued on August 26, 1999 (64 FR 46661), and February 25, 2000 (65 FR 10061), respectively. A summary of these decisions was added to the waste management discussion for both INEEL and SRS (Sections 3.2.11 and 3.3.11, respectively).

Cumulative Impacts

The cumulative impacts section (Section 4.11) was updated to reflect recent information obtained from the *Idaho High-Level Waste and Facilities Disposition Draft Environmental Impact Statement* (DOE 1999d) and the *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement* (DOE 2000).

Electric Energy Consumption

Section 4.14.3, Irreversible and Irretrievable Commitments of Resources, was revised to include electrical energy consumption associated with the alternatives under the proposed action.

Settlement Agreement and Consent Order with the State of Idaho

As a result of public comments concerning the contents of the Settlement Agreement and Consent Order with the State of Idaho, the entire document was included in the final EIS as Appendix K.

Melt and Dilute Driver Fuel at SRS

The option of using the melt and dilute process to treat sodium-bonded driver spent nuclear fuel at SRS was considered at the recommendation of a public comment. The option was dismissed from further evaluation as explained in the revised Section 2.6 of the final EIS.

Preferred Alternative

In accordance with requirements of the Council on Environmental Quality regulations (40 CFR 1502.14e), the final EIS incorporates DOE's Preferred Alternative for the treatment and management of sodium-bonded spent nuclear fuel. The Preferred Alternative is discussed in Section 2.8.

Transportation

The analysis was expanded to include the impacts from transporting the various waste forms and spent nuclear fuel packages from ANL-W to the INEEL Dry Storage Facility prior to transporting materials out of the State of Idaho by 2035.

Miscellaneous Revisions and Editorial Changes

Several sections in the SBSNF Final EIS were revised to reflect the availability of more recent data or to include corrections, improvements in the presentation, and other editorial changes. None of these revisions affects the environmental analysis presented in the EIS.

1.8 ORGANIZATION OF THE EIS

This EIS volume contains 9 chapters and 12 appendices. The main analyses are included in the chapters and additional project information is provided in the appendices. The 9 chapters provide the following information:

Chapter 1—Introduction: Background on the disposition of spent nuclear fuel; purpose and need for the proposed action; issues identified during the scoping and public comment periods; decisions to be made; and relationship of this EIS to other DOE NEPA actions and programs

Chapter 2—Proposed Action and Alternatives: Descriptions of sodium-bonded spent nuclear fuel; spent nuclear fuel treatment methods; spent nuclear fuel management facilities; alternatives considered; background information on the ultimate disposition of spent nuclear fuel; Preferred Alternative; and summary comparison of environmental impacts

Chapter 3—Affected Environment: Aspects of the environment that could be affected by the EIS alternatives

Chapter 4—Environmental Consequences: Analyses of the potential impacts of the EIS alternatives on the environment

Chapter 5—Environmental Laws, Regulations, and Consultations: Environmental, safety, and health regulations that would apply for this EIS's alternatives and the agencies consulted for their expertise

Chapters 6-9—Glossary; a list of preparers; a list of agencies, organizations, and persons to whom copies of this EIS were sent; and an index

The 12 appendices contain the following information: overview of the public participation process (scoping meetings and public comment period) and comment disposition; methods for assessing environmental impacts; detailed technology descriptions; characteristics of sodium-bonded spent nuclear fuel; normal operational impacts on human health; facility accident impacts on human health; evaluation of human health effects of overland transportation; environmental justice analysis; scientific terminology for ecological resources; *Federal Register* notices; the Settlement Agreement and Consent Order with the State of Idaho; and the contractor disclosure statement.

1.9 REFERENCES

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